PROSPECTS FOR SOVIET MANNED EARTH ORBITAL SPACEFLIGHTS

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SUMMARY

The Soviets have the bioastronautic and other capabilities to carry out complex earth orbital missions within the next few years. Available Soviet life support/environmental control technology and other operational spacecraft subsystems can be used for short duration earth orbital flights as well as laboratory and space station missions which are expected in the 1968-1970 period. Their automatic rendezvous and docking capability satisfies a major prerequisite for attempting manned orbital space station missions and allows the cosmonaut greater freedom for performance of tasks during rescue, ferry or supply missions.

Openly stated intentions and their need to resolve certain biomedical and technological problems make it likely that one or more manned SOYUZ flights, up to 10 days in duration and including extravehicular activity, will be attempted in 1968. If the earlier manned SOYUZ flight tests are successful, a three-man biomedical laboratory consisting of one or more SOYUZ modules could be orbited for 30-60 days, late in 1968 or in 1969. The same life support technology, capsule systems and automatic docking capability used in the SOYUZ are suitable for a six-eight man Proton-launched space station with a potential mission duration of up to one year or more, which could be orbited in the 1969-1970 period. Soviet plans to orbit huge, multi-manned, permanent earth orbital space stations probably could not be realized before 1972 if not several years later, because the necessary regenerative life support technology may not be operational before then.

DISCUSSION

Following a hiatus of over two years, the only Soviet manned spaceflight in 1967 (SOYUZ-1) crashed during the recovery phase after about one day in orbit, and resulted in the death of the pilot. No medical problems or life support system failures appear to have been involved. But even the spacecraft hardware problems which contributed to this disaster did not deter the Soviets, later in 1967, from accomplishing the outstanding man-related event of the year, i.e. automatic rendezvous and docking of two unmanned SOYUZ-type spacecraft. It appears that automatic rendezvous and docking is the mode which the Soviets intend to use, with or without a crew. Apparently they have decided not to rely upon human performance for this type of mission, although with men aboard, the spacecraft probably will include modes for emergency manual intervention. The Soviets now have a spaceflight capability which does not require primary reliance on man to control the spacecraft and frees him to perform mission tasks. Above all, the Soviets have satisfied one of the critical requirements for orbiting, maintenance, and construction of manned orbital space stations and probably for achievement of a manned lunar landing.

The Soyuz has a Voskhod-like reentry module for 3 men, a new cylindrical working and resting compartment, an instrumentation compartment and a docking adapter. The cylindrical compartment is about 9 feet in diameter and 10 feet long and the Voskhod spherical capsule extends about 4.5 feet into the compartment. The manned version (Soyuz-1) probably retained the same type of superoxide environmental control system used on previous Soviet manned spacecraft. In addition to the maneuvering capability, a major subsystem change was in the use of solar cells for electrical power. The approximately 1 kilowatt solar panel power supply level of Soyuz is sufficient to maintain the life support/environmental control systems for three men, and during daylight periods this capacity could be briefly upgraded to allow limited experimental activities.

Estimates of the injection weight of the SOYUZ spacecraft have varied from 12,500-14,500 pounds, based on telemetry indications and the 15,000 pound limit which its booster system (SL-4) can place into near-earth orbit. This new maneuverable spacecraft, somewhat heavier than Voskhod and with about twice the usable volume, would be a valuable adjunct to the Soviet interest in manned circumlunar flight as well as orbiting space stations and laboratories. In conjunction with the demonstrated automatic rendezvous and

docking capability this vehicle is suitable for rescue, ferry and supply, and thus could be used to support a long-lived orbiting space station. For example, available volume and expendable weight considerations indicate that the three man Soyuz could carry about 2500-3000 pounds of supplies, and about three times that amount if stripped down and unmanned.

The Soviets have stated a desire to fly earth orbital missions of increased duration during 1968 and probably have sufficient biomedical data to attempt manned flights of up to 30 days. Successful manned flights of this duration would assure life support capabilities more than adequate for ferry and supply missions (3 days), manned circumlunar flight (7 days), and a lunar landing and return mission (7 days). Current Soviet manned spaceflight objectives indicated by literature, spokesmen and intelligence sources, and Soviet mission requirements indicated by unresolved biomedical and technological problems suggest the following short duration earth orbital spaceflight events may occur during 1968.

1. A 1-5 day SOYUZ mission with a crew of up to 3 men (mid 1968)

2. A longer SOYUZ mission (possibly 10 days) involving extension of the earlier flight or a new flight. In the course of this mission another SOYUZ (manned
or or unmanned) will rendezvous and dock with the one already in orbit. The operation will include extravehicular activity and transfer of men from one spacecraft to the other. (Summer-Fall 1968)

As a result of ground-based simulations, psychological and physiological studies, the Soviets have expressed concern about the potential effects on man of flights of more than one month. But they appear to be planning for future mission durations of many months and even years. Soviet literature and private technical discussions have suggested that in the period up to 1970, they plan to orbit several manned laboratories with specialized biomedical and astrophysical tasks, and manned by 3-5 men; they plan to fly larger 6-8 man, long duration space stations orbited by the Proton launch system; and plan to use the Proton-launched modules for assembly of an even larger, long duration station complex which will be manned by as many as 20 crewmen. The Soviets also have discussed permanent orbit space station complexes weighing hundreds of tons with a crew of 50 or more, which they claim may be orbited sometime after 1970 or after a manned lunar

landing. The Soviets now have the capability to orbit manned laboratories (weighing 7 tons or more) and space stations (weighing up to 23 tons) which appear to be consistent with some of their reported objectives for the period up to 1970, using their available life support/environmental control systems, capsule subsystems, propulsion technology and automatic rendezvous and docking capabilities.

If the short duration SOYUZ manned spaceflights are successful, later in 1968 or early 1969, the Soviets could orbit an early manned laboratory using the SOYUZ configuration and a three-man crew. Judging by their stated requirements, the major purpose of this mission would be to study potential phychological, physiological and work capacity problems during a flight of 30 days or longer. Complex extravehicular activities would be included. This mission also might involve a ferry and supply test flight by another (manned or unmanned) SOYUZ spacecraft. Based on the estimated configuration and Soviet use of the SL-4 booster system for these spacecraft, three men in the Soyuz, with solar cell power and the available superoxide environmental control system and life support technology, could be maintained in orbit for 30-60 days without resupply. Alternatively, a Soyuz class resupply vehicle could be docked with the laboratory, maintained as a temporary storage source, and thereby extend the mission duration. By using an airlock on the Soyuz reentry vehicle or crawling through the docking adapter, the crew might be maintained in orbit for extended periods or replaced, by means of periodic transfers to fresh Soyuz modules docked to the original laboratory. There is the further possibility that the Soviets will use several rigidly docked Soyuz modules as an orbital laboratory complex.

By utilizing their superoxide life support/environmental control technology, solar cell power (upgraded to 5-6 kilowatts), other available capsule subsystems, and the SL-12 booster technology within the next two years (1969-70), the Soviets could orbit a space station weighing approximately 50,000 pounds and capable of carrying a crew of 6-8 men. With the SOYUZ spacecraft as a ferry and supply vehicle and the automatic rendezvous and docking capability, the Soviets could extend the operational lifetime of this station up to one year or more. Such a station would include ample volume, expendable weight potential, and power supply for considerable experimental activities or other mission-oriented tasks. Based on indications from the Soviet literature, the considerable weight advantage, and the requirement for fewer flight tests, the most likely launch mode for this Soviet space station would be to place an unmanned capsule in orbit which would be entered later by a crew from Soyuz-type ferry vehicles docked to the

station. Subsequently, the crew could be augmented or exchanged in the same fashion.

Consistent with speculative predictions in their literature, by 1970-1971 the Soviets could achieve a space station weight of several hundred thousand pounds by utilizing a reported new booster system or by assembly of Proton launched modules in orbit; i.e. their automatic rendezvous and docking system could be fitted to 50,000 pound spacecraft. However the slower paced development of the highly advanced environmental control/life support technology required for such a large, multi-manned station probably would defer this mission towards the middle of the decade (1972-1975). Available non-regenerative superoxide technology would be uneconomical because of extraordinary weight penalties for storage and a massive resupply requirement. Operational hardware for partially regenerative systems which may be suitable for early versions of very large stations, probably will not be available before 1972 or later. An operational closed cycle or bioregenerative system which is the technology of choice for huge space station complexes, probably will not be available before 1980. Although the Soviets have given provocative reasons for such a venture many of the objectives for a very large, permanent station probably could be accomplished by 50,000 pound stations. Furthermore, potential biomedical problems such as the effects of prolonged weightlessness, isolation, and radiation hazards, probably will require several years of study with long duration intermediate size space stations.